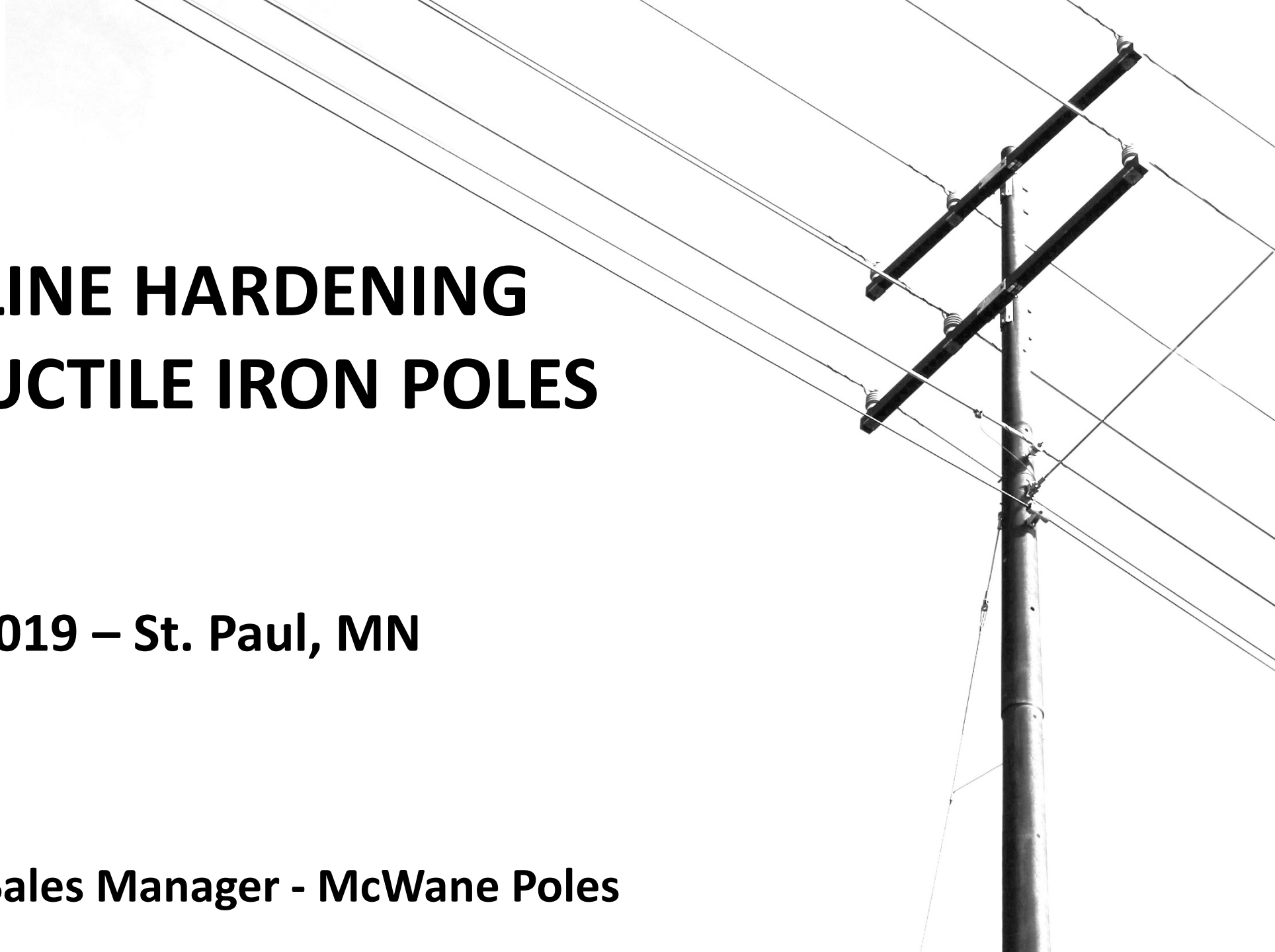
SYSTEM LINE HARDENING USING DUCTILE IRON POLES



MIPSYCON 2019 – St. Paul, MN

Marc Dray

North Region Sales Manager - McWane Poles

Warm up question #1

What year did the University of Minnesota football team last win the Big Ten Conference?

A. 1957
B. 1967
C. 1977
D. 1987
E. NEVER

Warm up question #2

How many national championships has the University of Minnesota men's hockey team won?

A. 0

B. 3

C. 5

D. 7

E. 9

Warm up question #3

What Minnesota Vikings QB has the record for most TD passes (7) in one game?

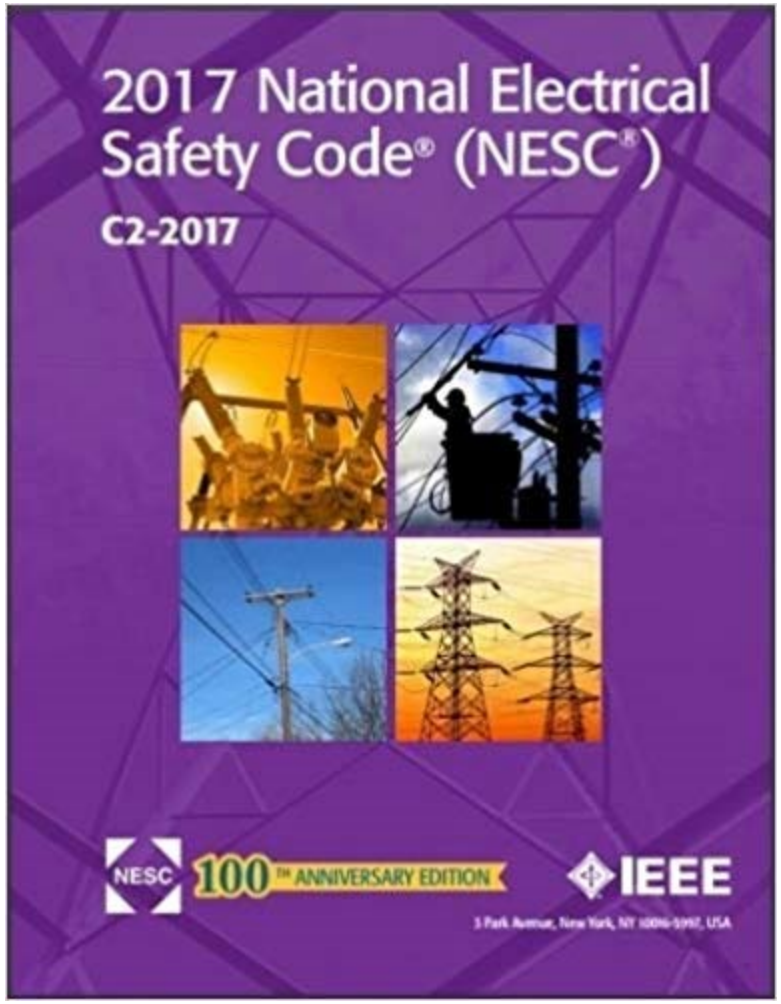
A. Daunte Culpepper
B. Fran Tarkenton
C. Joe Kapp
D. Warren Moon
E. Rich Gannon
F. Tommy Kramer
G. Brett Favre

Aging Infrastructure

- Critical Assets such as poles are aging well beyond their design service life causing wide spread damage and outages.
- As our electrical equipment and systems get older, they are deteriorating… Causing failures and rendering our systems unable to perform as needed during periods of extreme summer and winter storms.

Infrastructure Hardening Options

- The National Electric Safety Code (NESC) is the foundation upon which many utility standards are built.
- Damage from hurricanes and wind storms has shown that building to such standards alone may suffice for normal weather, but not necessarily for some of the severe weather events resulting in some catastrophic failures and subsequent extended outages.



System Hardening using Non-Wood Poles

- Every year storms cause major outages on electric utility systems…
- How can your utility avoid problems related to aging wood poles?
- Why does your utility need to be worried about wood pole strength?
- What products are available that can reduce the risk of outages caused by downed poles?

Upgrading of Poles

- The most common hardening practice for electric T&D systems is upgrading poles and structures with stronger materials.
- This typically comprises upgrading wooden poles to steel, concrete or a composite material.
- T&D structures are typically upgraded to meet certain grade & wind loading criteria as defined by the National Electrical Safety Code.

Why is System Hardening important?

Snow & Ice Storms

High Wind Storms

Weakened poles can cause cascading failures…

Poles may appear to be acceptable until they are tested by strong storms.

Poles must be designed to handle the extra weight from joint users like phone, cable TV, and internet services.

Aging wood poles can cause long and expensive outages to occur…

Despite being an inexpensive first cost option, wood poles are susceptible to ground rot, fungus, and woodpeckers.

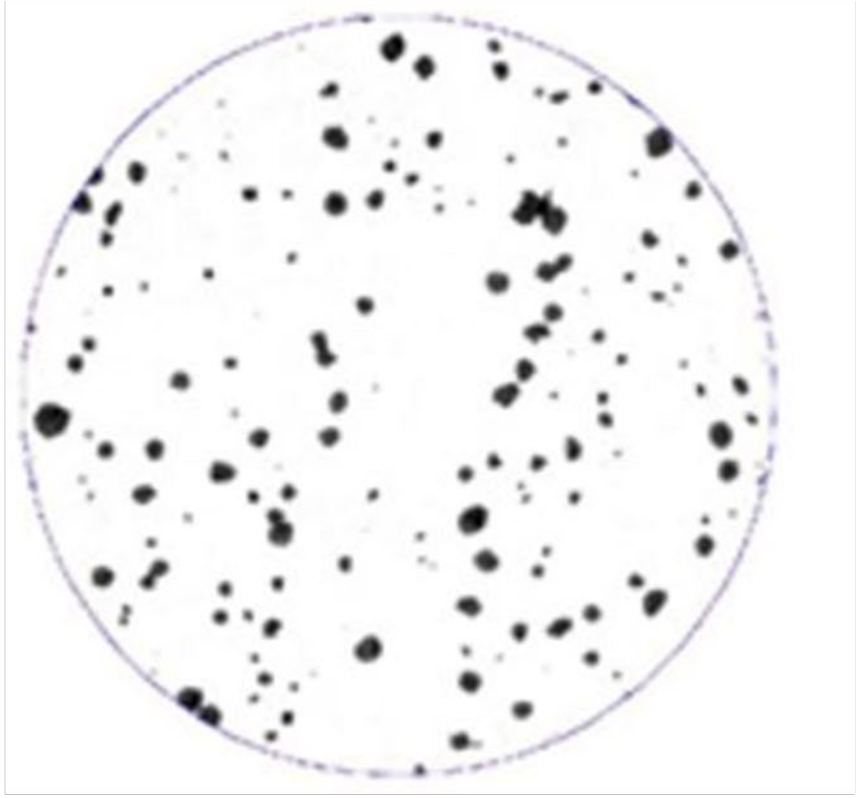
Most utilities are forced to have a vigorous wood pole inspection program to treat or condemn damaged poles. Unfortunately, this is an expensive process that must be repeated every few years and pole treatments only prolong required pole replacements.

Non-Wood Pole alternatives

1. Concrete (cast & spun)
2. Steel (tubular and multi-sided)
3. Fiberglass (and various composites)
4. Ductile Iron (made from recycled steel & iron)

Ductile Iron

Chemistry: Gray Cast vs. Ductile Iron



Common Uses for Ductile Iron:

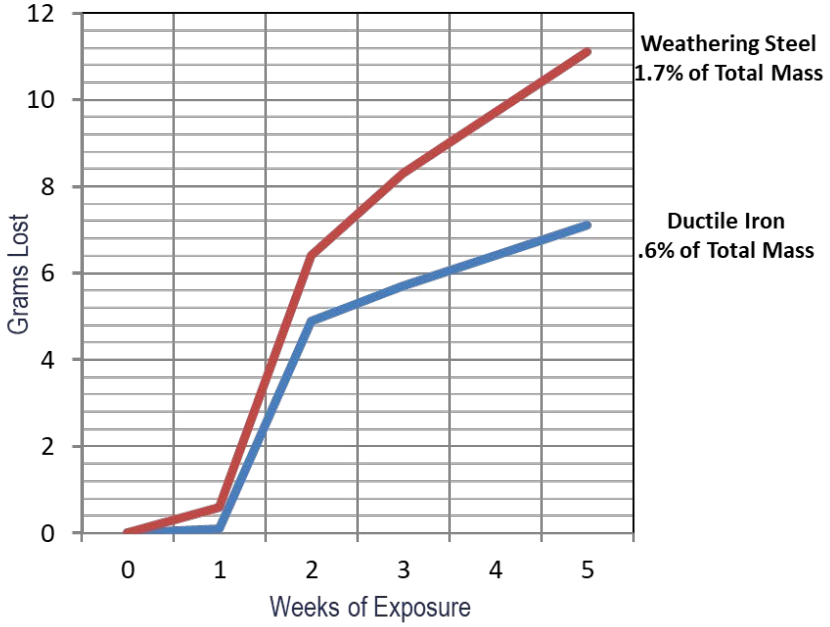
Benefits of Ductile Iron Poles

Corrosion Resistance

Natural Ductile Iron

Weathering Steel

ASTM B117 Salt Fog Test



Fire Performance Testing

Completed the following testing of their product to give their customers an understanding of how it may perform in certain situations.

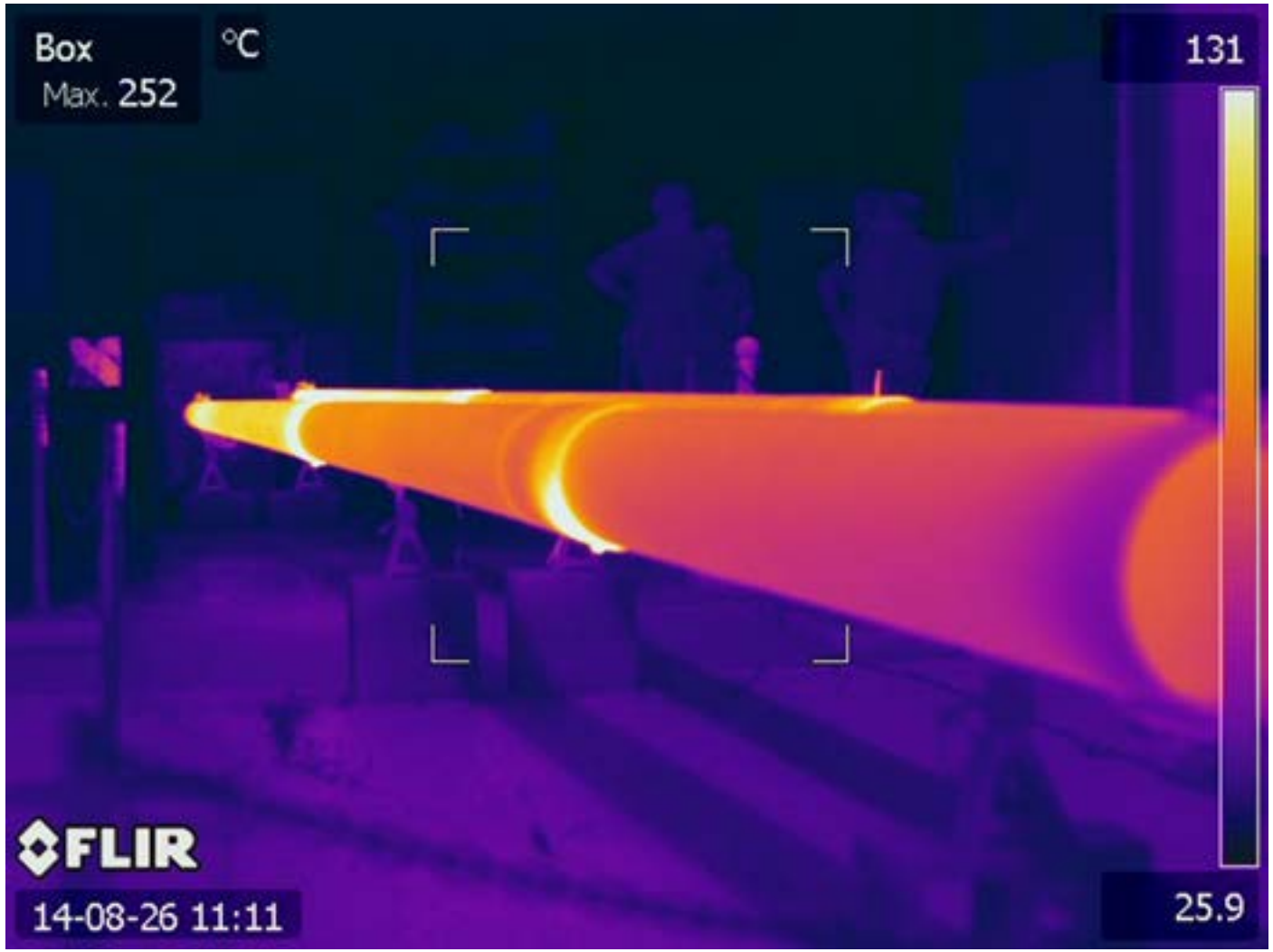
Completed Studies

- Western Fire Center, Inc.
- Induron Coating Performance
- Heat Exposure Testing (In Process)

WFCI
WESTERN FIRE CENTER, INC.

Conductivity Testing

AEP testing verifies that Ductile Iron poles are more conductive than a 4/0 copper wire.

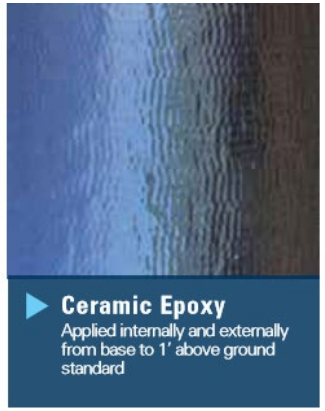


Resistance to Mother Nature

Sustainability

Product is made of 95% Recycled Material and 100% Recyclable

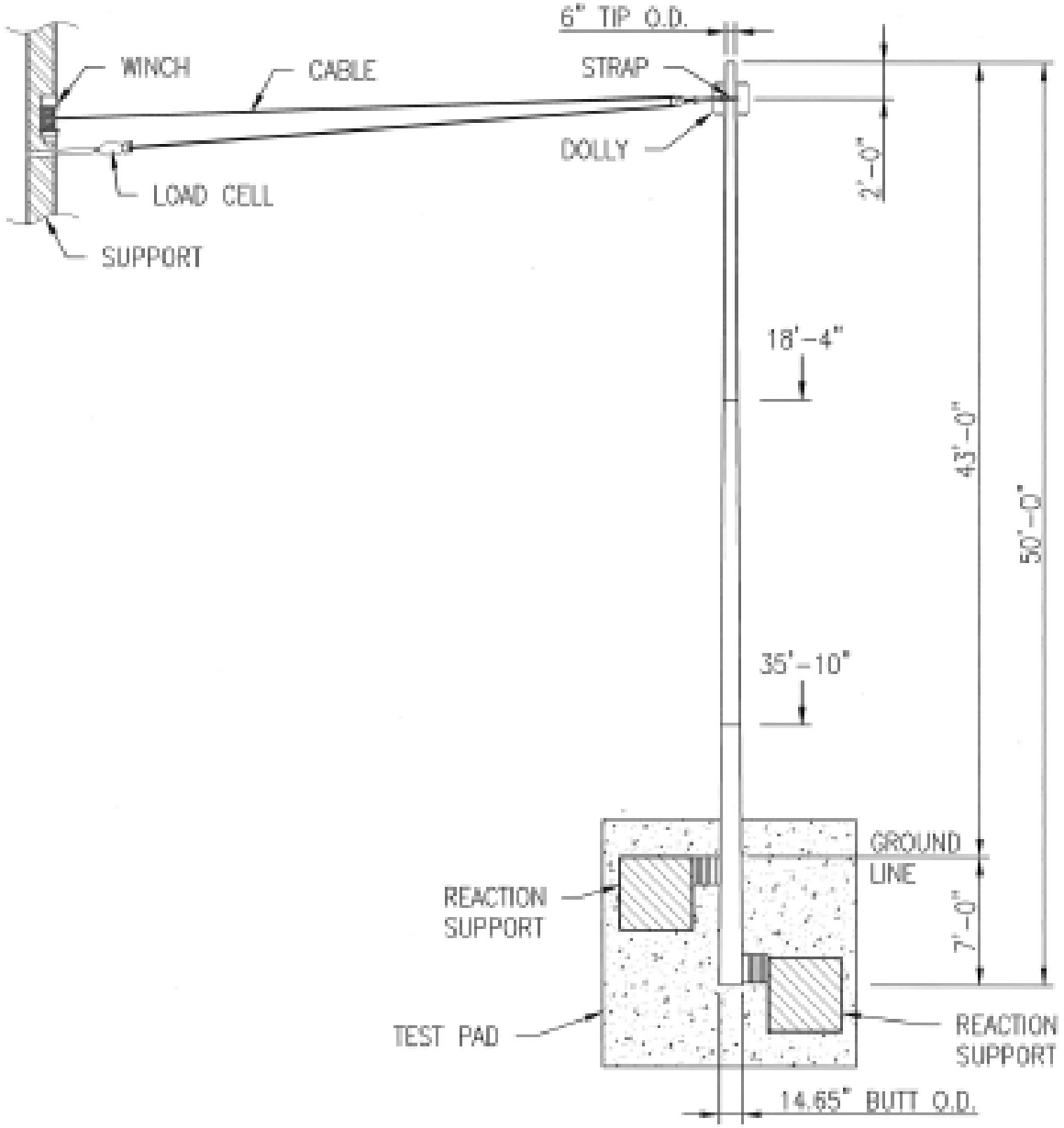
Ceramic-Epoxy Embedment Coating



Wood pole treatments

Load Testing

Full Scale Test for Class 1 50’



Class 1 50’

(Pole secured @ ground line with a load applied 2’ from tip).

100% of Class 1 Load: 2.95 kips, 43 inch deflection.

130% of Class 1 Load:
3.84 kips,
58 inch deflection.

173% of Class 1 Load:
5.1 kips (prior to break),
103 inch deflection.

Product Testing Results – C1 50’

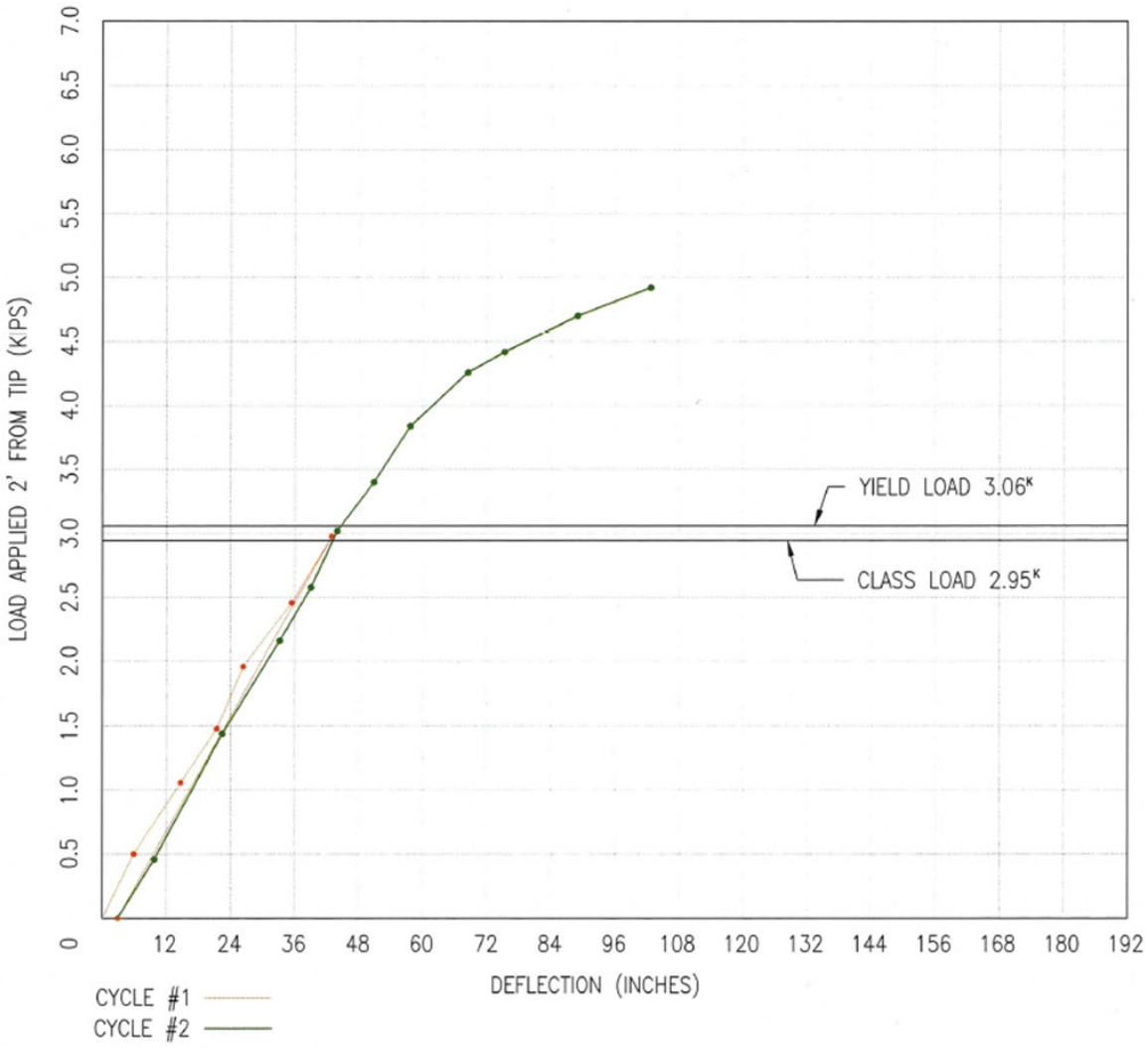


FIGURE 2
TEST RESULTS FOR 50/1

Product Support Areas

Transmission and Distribution Applications

Distribution Applications

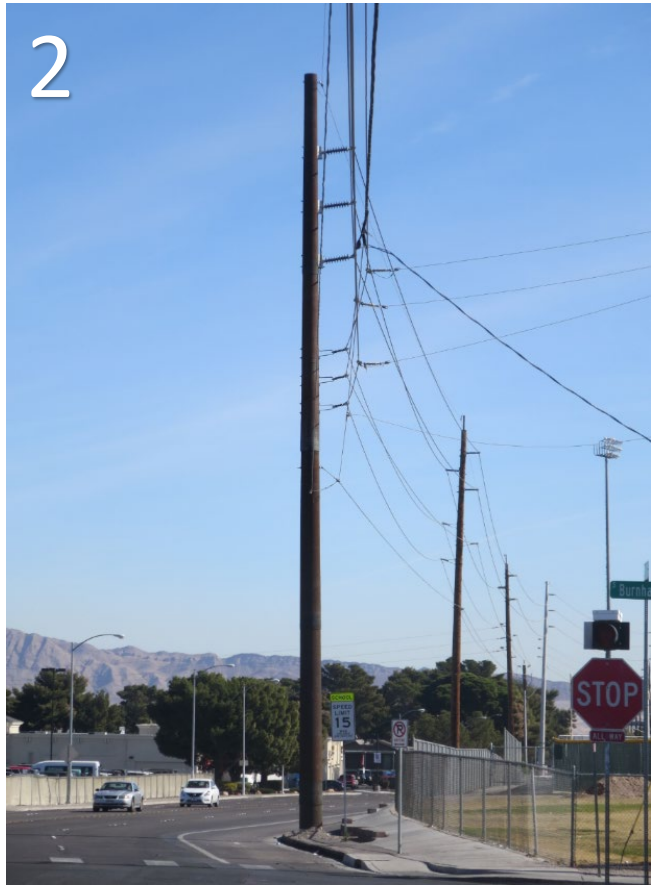
Critical and asset poles (AL)

Storm-hardening pole (OK)

Replacing wood & concrete (FL)

Transmission Applications

N. Idaho: Rebuilt 115kV DI pole line after wild fire completely destroyed wood poles.



Nevada Energy: H6 80’ unguyed angle pole for 69kV & 13kV near Las Vegas, NV.

Central Power G&T: Rebuilt 115kV H-Frame in a protected wetland near US/Canada border near Minot, ND.

In the Field

Field Assembly

70’ and Less are Shipped Fully Assembled

Ease of Field Assembly

Installation

Lighter weight, small pole butt, easy to drill, no copper ground wire required.

Why Ductile Iron Poles?

Engineered Product

- ANSI O5.1 - Grade B
- Structural and dimensional consistency.
- High residual strength compared to wood.
- No re-tightening of hardware.
- PLS CAD library file available upon request.

Lower Life-cycle Cost

- Superior in corrosive environments.
- Impervious to rot, insects, and woodpeckers.
- Estimated life of 75-100 years.
- No environmental fees for disposal - 100% recyclable.
- Cash value when taken out of service.

Lineman Friendly

- Installed with standard equipment and hardware.
- Much easier to drill than steel or concrete – hole takes about 30 seconds to drill.
- Typically 25-30% lighter than wood.
- Pole is self grounded; so no copper required.

Weathered Finish

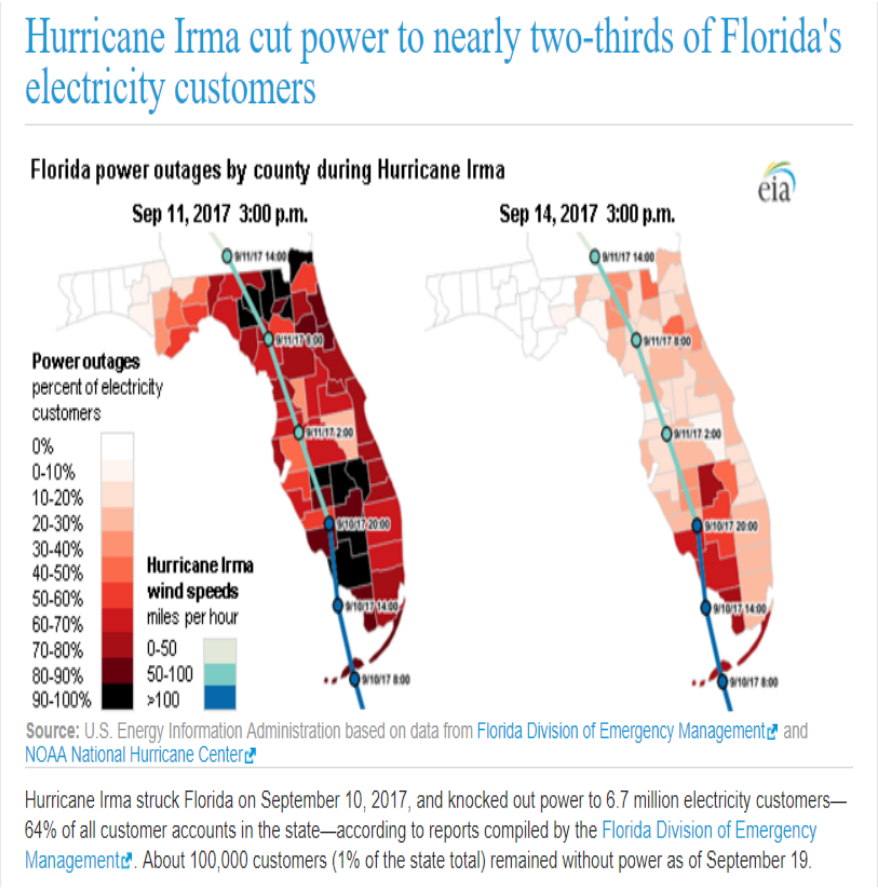
- Looks like wood after weathering.
- Aesthetically similar to “weathering” steel.
- Initial oxidation protects pole from further deterioration.

Coated Finish

- Arc-applied zinc, base-coat with acrylic top coat.
- Coated finish for aesthetics or extreme environments.
- Custom colors available.

Success Stories

Florida Keys



600 wood & concrete poles lost during 2017 Hurricane Irma are replaced by foreign crews with coated Ductile Iron Poles.

Cimarron Elec COOP

- 2002 ice storms brought down 16,000 wood poles.
- 2013 ice storm caused 800 wood poles to fail.
- Rebuilt 1250 miles of distribution using (4) ductile iron poles per mile.

Cimarron Electric Cooperative took a proactive approach to strengthening its distribution system and saved its members millions of dollars by preventing system cascading during the holiday ice storms of 2015.

Cimarron, one of Oklahoma's largest electrical cooperatives, is no stranger to ice storms. In 2002, two ice storms brought down approximately 16,000 poles, which cost the utility tens of millions of dollars. And a 2013 storm caused more than 800 poles to fail. Because of the utility's hundreds of miles of straight distribution lines, a single pole failure can lead to the cascading failure of tens of miles of line at a time.

After 2013, the utility committed to increasing the storm resiliency of its system by changing its standard construction practices. The utility partnered with G.H. Guernsey, a consulting engineer in Oklahoma City, to design a stronger system and rebuild 1,250 miles of its distribution system. Changes included shortening span lengths and installing at least four Class 1 McWane ductile iron poles per mile, with two poles being storm poles (pictured below). The storm poles are effectively inline dead ends because they are guyed in opposite directions in line with the circuit.

A Cimarron Electric Cooperative three-phase distribution circuit with a ductile iron storm pole.

The remaining 18 poles per mile are Class 3 wood poles. Cimarron depends on the ductile iron storm poles to limit the cascading of the other poles.

The new system was first tested in May of 2015 when a tornado touched down in Orienta, Oklahoma. The twister took out four wooden poles and transported the conductor a half mile perpendicular to the line at the next standing pole. However, damage stopped at the first ductile iron storm pole. Few expected the poles to withstand a tornado's high winds and flying debris, but needless to say, the utility was happy with the results. The utility anxiously awaited the next major ice storm to prove the effectiveness of the new storm design.

WINTER STORM GOLIATH

On December 27, 2015, winter storm Goliath brought heavy freezing rain, which accumulated as ice on Cimarron's distribution system. Goliath was the storm that Cimarron had been waiting for to test its new storm-hardening strategy. Heavy ice and high winds caused the utility to lose 1,158 poles and hundreds of crossarms in areas where poles did not fail. In total, the storm damage is expected to cost $8.5 million.

There was good news, however. Not a single ductile iron or wood pole fell in the 750 miles that had been rebuilt as part of the storm resiliency project. Regarding the performance of McWane's ductile iron poles, Reed Emerson, Cimarron's Senior Vice President of Engineering and Operations, said, "they just work…they did exactly what they were designed to do — stop the domino effect." In total, the utility lost 1,400 wood poles in the November and December 2015 ice storms, but this is much less than if the rebuild had not been done. Some say the magnitude of ice and wind in Goliath was worse than the storm of 2002. The utility estimates that the cost for an emergency rebuild is roughly $60,000 per mile, so it is reasonable to estimate that the utility saved millions of dollars.

DUCTILE IRON POLES ARE NEW STANDARD

Cimarron now incorporates ductile iron poles into its routine construction practices and installs two ductile iron poles per mile for single-phase construction and four poles per mile for three-phase construction.

Application Photos

55’ H1
Stigler, OK

45’ Class III
Angle Pole in TN

Riser Pole
Arapahoe, NE

Equipment Pole
Morristown, TN

40’ Class III
Waterloo, IA

65’ Class I
York, NE

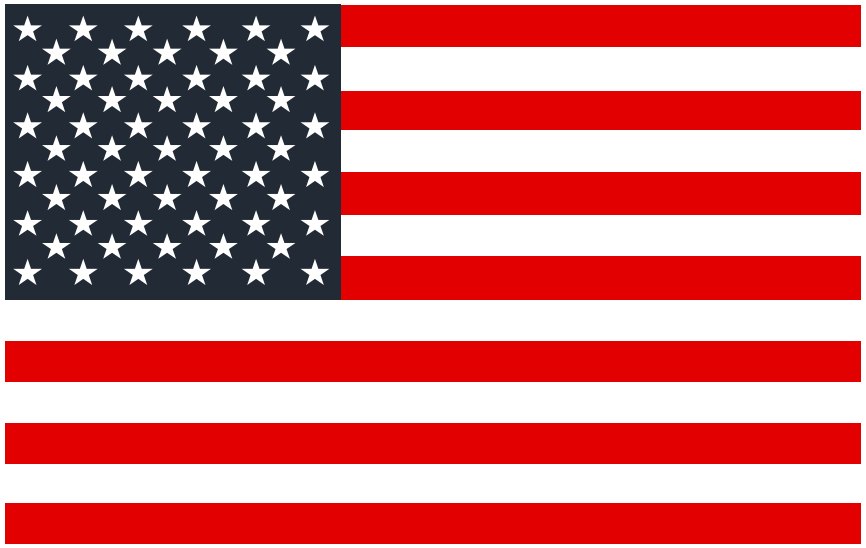
50’ H1
Substation Transition
Sweetwater, TN

70’ Class III
Communication Tower
Lexington, NE

Self Supporting Structure
San Angelo, TX

Extreme Coating Pole
Key Largo, FL

Goal:
Avoid costly pole maintenance and changeouts… Set a lineman friendly permanent ductile iron pole one last time!



Thank you!
Any questions?